SUMMARIES OF CURRENT NORTH AMERICAN PRE-CAMBRIAN LITERATURE.[1]

HOVEY,[2] in notes on the Isles of Shoals, of Maine and New Hampshire, states that the general rock constituting these isles is granitic, varying in color from white to black, and that this is cut by later dikes.

Hitchcock, C. H.,[3] gives a general account of the geology of New Hampshire, including a sketch of the work and conclusions of the first and second New Hampshire state surveys and of subsequent workers in the field. Some of the modifications indicated by work done since the close of the second state survey are: (1) Archean rocks exist as oval areas in the Stamford gneiss and south of Mt. Killington, Vt., in the Hinsdale, Mass., area, the Hoosac Mountain, and elsewhere. (2) The masses of Bethlehem gneiss are batholites, with inclusions of adjacent mica-schists. (3) A study of several areas of hornblende-schist proves that they are igneous.

Daly[4] discusses the porphyritic gneiss of New Hampshire, and concludes that it is an eruptive porphyritic granite, at least in its three most important areas, of post-Devonian age.

Cushing[5] mentions pre-Cambrian rocks in Saranac township and Beekmantown, N. Y. These comprise gneisses and gabbro, upon which the Cambrian rests unconformably.

[1] Continued from page 756, Vol. IV., JOUR. GEOL.

The summaries of current pre-Cambrian literature which have heretofore been made by C. R. Van Hise will be continued by C. K. Leith.

[2] Geological notes on the Isles of Shoals, by H. C. HOVEY (Abstract): Proc. Am. Assoc. Adv. Sci., for 44th meeting, 1895, pp. 136, 137.

[3] The geology of New Hampshire, by C. H. HITCHCOCK: JOUR. GEOL., Vol. 4, 1896, pp. 44–62.

[4] Studies on the so-called Porphyritic Gneiss of New Hampshire, by R. A. DALY: JOUR. GEOL., Vol. 5, 1897, pp. 684–722, 776–794.

[5] Geology of Clinton county, N. Y. (preliminary), by H. P. CUSHING: Report of the State Geologist of New York for 1893, pp. 475–489.

Cushing[1] argues the existence of pre-Cambrian as well as post-Ordovician dikes in the Adirondacks and along Lake Champlain, offering the following reasons: (1) A much larger number of dikes occur in the pre-Cambrian than in the Paleozoic rocks. (2) A great proportion of the dikes are of diabase, while diabase rocks are not found outside of the pre-Cambrian areas. (3) Along the line of contact of the Potsdam with the older rocks north of the Adirondacks, the plentiful diabase dikes in the older rocks are apparently cut off by the Potsdam.

White[2] describes and maps the geology of Essex and Willsboro' townships, Essex county, N. Y. The Archean rocks of the townships comprise the following: (1) Labradorite rocks, gabbros, norites, and anorthosites, occupying the western half of the area, west of the Boquet River; (2) the metamorphic crystalline limestones and ophicalcites in the northeastern part of the area on Willsboro' Bay, and in the southeastern part of the area on the ridge of Split Rock Point; (3) gneisses and granites, chiefly on Split Rock Point. Following Adams,[3] all of these rocks are classed as Norian or Upper Laurentian.

Kemp[4] describes the geology of Essex county, N. Y. The pre-Cambrian succession in this county is as follows: (1) A gneissic series consisting of red and gray orthoclase gneisses, usually laminated, but at times rather massive. In these gneisses are the workable iron ores of the Adirondacks. (2) Apparently resting on (1), a series of crystalline limestones, ophicalcites, black hornblendic pyroxenic schists, and thinly laminated garnetiferous gneiss. Pegmatite veins are a frequent associate of these rocks. (3) A series of rocks of the gabbro family, ranging from aggregates of labradorite through

[1] On the existence of pre-Cambrian and post-Ordovician trap dikes in the Adirondacks, by H. P. CUSHING: Trans. N. Y. Acad. Sci., Vol. 15, 1896, pp. 248–252.

[2] The geology of Essex and Willsboro' townships, Essex county, N. Y., by T. G. WHITE: Trans. N. Y. Acad. Sci., Vol. 13, 1894, pp. 214–233, Pls. VI and VII.

[3] Ueber das Norian oder Ober-Laurentian von Canada, F. D. ADAMS: Neues Jahrb., B. B. VIII, p. 423.

[4] J. F. KEMP: Geology of Essex county (preliminary). Report of State Geologist of New York for 1893, pp. 433–472. See also The Geology of Moriah and Westport townships, Essex county, N. Y. Bull. N. Y. State Museum, Vol. 3, 1895, pp. 325–351. With a geological map.

varieties with increasing amounts of bisilicates to basic olivine gabbros. The gabbros vary from massive to gneissoid rocks which are difficult to discriminate from some of the gneisses of series 1. These rocks contain the titaniferous iron ores. They are intrusive in series 1 and 2. Resting unconformably upon 1, 2, and 3 is the Potsdam sandstone.

Kemp[1] describes the geology of the magnetites near Port Henry, N. Y., and especially those of Mineville in the Adirondacks of New York. The oldest rocks present in the district are quartzose gneisses and white crystalline limestones, with perhaps some more basic gneisses. The limestones appear to lie largely in the upper part of this group, but some of them are certainly below the other members. The acidic gneisses may have been granites or quartz-diorites. The gneiss and limestone group is cut by anorthosite intrusives, and both are in turn cut by gabbro intrusives. Trap dikes, usually of small width, are very common in this district. The age of these dikes is undetermined, but it seems probable that they may be of two ages, pre-Potsdam and post-Utica. Overlying unconformably all of the above described rocks is the Potsdam sandstone.

Darton[2] describes and maps the faulted region of Herkimer, Fulton, Montgomery, and Saratoga counties, New York. Laurentian rocks occupy the northern part of the area, forming the floor for a succession of sandstones, limestones, and shales, which dip to the south at a very moderate angle.

Kemp[3] describes the East River and Blackwell's Island section made by an underground tunnel at 70th street, New York City. Under the west channel is a fine grained mica-gneiss, containing pegmatite seams. Under Blackwell's Island and the adjacent waters is a gray gneiss. In the center of the east channel is a dolomite,

[1] The geology of the magnetites near Port Henry, N. Y., and especially those of Mineville, by J. F. KEMP: Trans. Am. Inst. Min. Engineers, Chicago meeting, Feb. 1897, p. 58.

[2] A preliminary description of the faulted region of Herkimer, Fulton, Montgomery, and Saratoga counties, by N. H. DARTON: 14th Ann. Rept. Geol. Survey of New York, for 1894, pp. 31–56, 1896. With geological map. Published in the 48th Ann. Rept. N. Y. State Museum, 1895.

[3] The geological section of the East River at 70th Street, New York, by J. F. KEMP: Trans. N. Y. Acad. Sci., Vol. 14, 1895, pp. 273–276.

which is flanked on the east side by mica-schist, locally pegmatized. Beyond the mica-schist on the Ravenswood shore is a massive hornblende-gneiss or granite, which is thought to be intrusive.

Merrill,[1] in connection with a report on the mineral resources of New York, publishes a geological map of the entire state and a large scale geological map of the southeastern part of the state. These maps embody information available to date concerning the distribution of the pre-Cambrian rocks of New York.

Merrill,[2] in connection with a report on road materials of New York, publishes a map of the state showing distribution of pre-Cambrian rocks.

Bascom[3] describes and maps pre-Cambrian volcanic rocks of South Mountain, Pennsylvania. The volcanic rocks are both basic and acid. The acid rocks comprise quartz-porphyries, devitrified rhyolites or aporhyolites, with accompanying pyroclastics, and sericite-schists, the last being the metamorphosed forms of the quartz-porphyries and aporhyolites. The basic rocks comprise melaphyres, augite-porphyrites, slates, and pyroclastics. Lithologically the volcanic rocks resemble the Keweenawan copper-bearing rocks of Lake Superior.

There is not sufficient evidence to decide the comparative age of the basic and acid rocks, but field observations in the Monterey district indicate that the acid rocks are the older. The volcanics are overlain, with stratigraphical unconformity, but with structural conformity, by sedimentary rocks of Lower Cambrian age. Both volcanics and sedimentaries have been subjected to strong dynamic action, whereby the igneous rocks have been cleaved and sheared, and the sedimentary rocks thrust over them from the east.

Kemp[4] describes the ore deposits at Franklin Furnace and Ogdensburg, N. J., and briefly sketches the general geology of the area. The

[1] Mineral resources of New York State, by F. J. H. MERRILL: Bull. N. Y. State Museum, Vol. 3, No. 15, 1895, pp. 365–595.

[2] Bull. N. Y. State Museum, Vol. 4, No. 17, 1897, pp. 90–134. With maps.

[3] The ancient volcanic rocks of South Mountain, Pa., by FLORENCE BASCOM: Bull. U. S. Geol. Surv., No. 136, 1896, pp. 124. With geol. map.

[4] The ore deposits at Franklin Furnace and Ogdensburg, N. J., by J. F. KEMP: Trans. N. Y. Acad. Sci., Vol. 13, 1893, pp. 76–98.

ore deposits occur in white crystalline limestone, which is cut in numerous places by dikes of granite, trap, and a rock taken to be altered gabbro. The white limestone is closely involved throughout its extent with a blue limestone of Cambrian or Cambro-Silurian age.

Wolff[1] briefly describes the eruptive rocks of Sussex county, New Jersey, with reference to their economic value. These include granite, elaeolite-syenite, elaeolite-porphyry, and camptonite, and are treated under the head of Archean.

Westgate[2] describes and maps the geology of the northern part of Jenny Jump Mountain, in Warren county, N. J. The main ridge of the mountain is formed chiefly of gneisses, comprising many varieties. These are, from northwest to southeast, and also, according to the banding, from base to top (1) granitoid-biotite-hornblende-gneiss, containing narrow bands of biotite-hornblende-gneiss; (2) hornblende-pyroxene-gneiss; (3) biotite-gneiss; (4) dark biotite-hornblende-gneiss; (5) granitoid-biotite-hornblende-gneiss; and (6) dark biotite-hornblende-gneiss, and gray micaceous gneiss. Certain of the dark hornblende-gneisses have been so extensively altered as to be called epidote rocks. The gneisses are in general granitoid and massive, and there is a conspicuous absence of schistose rocks and crumpling of the banding, the banding over wide areas having uniform strike and dip.

Along the southeast side of the mountain, at the northeast end of the mountain, and in two isolated outcrops within the gneisses of the main ridge, are areas of white crystalline limestone. The limestone is in all cases closely associated, and perhaps interbanded, with the dark biotite-hornblende-gneiss and gray micaceous gneiss (Nos. 4 and 6 above), and at the northeast end of the mountain also with quartz-pyroxene rock.

Cutting both gneisses and limestone are pegmatite, diabase, and amphibolite or granular diorite.

The origin and age of the gneisses are doubtful. The presence of limestone belts closely associated, and perhaps interbanded with the

[1] Report on Archean geology, by J. E. WOLFF: Ann. Rept. Geol. Surv. New Jersey, 1896, pp. 91–94. With map.

[2] The geology of the northern part of Jenny Jump Mountain, in Warren county, N. J., by LEWIS C. WESTGATE: Geol. Surv. of New Jersey, Ann. Rept. for 1895, pp 21–61, 1896. With geol. map.

hornblendic and micaceous gneisses, and the presence of magnetic iron ore, suggest a detrital origin for at least a part of the gneisses, and consequently their reference to the Algonkian. There may be really two series of rocks: (1) A series of limestone and associated interbedded rocks, of sedimentary origin, and (2) a series of more massive granitoid gneisses, probably older, and of unknown origin. This supposition is based only on the fact that the limestones are persistently associated with the hornblendic and micaceous gneisses and quartz-pyroxene rock, and are not found associated or in contact with the light colored granitoid gneisses which constitute the main mass of the mountain. However, there is not sufficient evidence to refer a a part of the gneisses to the Algonkian, and all are therefore classed as pre-Cambrian.

The crystalline limestones are believed to be distinct from and older than the blue magnesian limestone of Cambrian age, which occurs along the northwestern side of the New Jersey Highlands, and and which outcrops in isolated areas in the valleys adjacent to Jenny Jump Mountain, for the following reasons:

1. They differ lithologically from the blue limestone in being thoroughly crystalline, and in containing large amounts of accessory metamorphic minerals, showing that they have been subjected to general metamorphic forces of which the neighboring blue limestone shows no trace.

2. They occur in intimate association with the gneisses, which are of admitted pre-Cambrian age.

3. They show no intimate association in areal distribution with the blue limestone, nor any tendency to grade into it.

4. The metamorphic changes to which the white limestones have been subjected are general in their nature, and not due to the action of eruptives by which they are cut; so that no sufficient agent is at hand to account for the supposed change from blue into white limestone. The white crystalline limestones are therefore believed to be of pre-Cambrian age.

Williams and Clark[1] describe and map the geology and physical features of Maryland. The pre-Cambrian rocks, described by Williams,

[1] Geology and physical features of Maryland, by G. H. WILLIAMS and WM. B. CLARK: Extract from World's Fair Book on Maryland, Baltimore, 1893, pp. 1–67. With map.

form the eastern or holocrystalline division of the Piedmont Plateau region of Maryland, crossing the state in a general southwest direction from the southeast corner of Pennsylvania and the north end of Delaware. These rocks are but a part of the great crystalline plateau which extends from New York to Alabama along the eastern base of the Appalachians. Towards the east the pre-Cambrian rocks of Maryland plunge under Coastal Plain deposits, and toward the west they form the floor to support the Paleozoic strata of the Appalachians, reappearing in the granitic and volcanic rocks of South Mountain of Pennsylvania. The holocrystalline rocks are divisible into six types, three of which, gabbro, peridotite or pyroxenite, and granite, are of undoubted eruptive origin, and three of which, gneiss, marble, and quartz-schist, while showing no certain evidence of clastic structure, are believed to be sedimentary. The prevailing rock is gneiss, closely associated with marbles and quartz-schists, forming an intricate complex. The complex shows evidence of great dynamic action, the rocks, having been almost completely recrystallized. The eruptive rocks are all younger than the gneisses. The gabbro is the oldest, followed by the peridotite or pyroxenite, and the youngest is the granite. The granites are as a rule medium-grained biotite-granites, but they frequently take the form of pegmatite.

Williams[1] considers the general relations of the granitic rocks in the Middle Atlantic Piedmont Plateau and maps the same. The criteria by which ancient plutonic rocks in highly metamorphosed terranes may be recognized comprise radiating dikes, inclusions of fragments, contact zones, chemical composition, and petrographical structure. On these criteria it is concluded that most of the granitic rocks of Maryland are igneous, although many of them are changed to granite-gneiss, and of certain of these gneisses it cannot be asserted whether they are of aqueous or of igneous origin. South of Laurel, in the large area from Triadelphia southward to Brookville, at Murdoch Mill west of Washington, south of Falls Church in Fairfax county, Va., and at Cabin John Bridge on the Potomac River, there are gradations between granitic rocks and diorites or gabbros. In the Maryland

[1] General relations of the granitic rocks in the Middle Atlantic Piedmont Plateau, by GEORGE H. WILLIAMS. Introduction to Origin and Relations of Central Maryland Granites, C. R. KEYES, Fifteenth Ann. Rept., U. S. Geol. Surv., 1895, pp. 659-684, Pls. XXVII–XXXV.

rocks pegmatites are abundant. Some of these are, as indicated by their association with quartz veins and by parallel banding, water segregations. The majority, however, are igneous, as is shown by all of the phenomena of intrusive rocks.

Comments.—The description and discussion of the origin of the pegmatites are of great interest. From the descriptions it is clear, although Dr. Williams does not definitely say so, that there are nearly all gradations from material which is plainly a vein quartz deposit, through others where we have quartz and feldspar with a banded arrangement, and are water segregations, to the pegmatites which have distinct igneous characteristics. This region thus affords a beautiful illustration of Van Hise's[1] conclusion that under proper conditions water and liquid rock are miscible in all proportions, and that pegmatization comprises water impregnation, true igneous injection, and all intermediate processes.

Clark[2] describes the geology and physical features of Maryland. This account is essentially the same as that published by Williams and Clark[3] in 1893, and previously reviewed. Here, however, the crystalline rocks are classed as Archean and Algonkian, both of which are included under the general term Archean. The statement is made that there is no positive evidence that there are represented in Maryland rocks of the earliest portion of Archean time (meaning Archean proper), although a part of the gneiss complex may represent it. The Algonkian period, however, is represented by many varieties of rock. The rapidity with which the crystalline rocks furnished sediments for the overlying formations points to their high elevation in Archean time.

In the western division of the Piedmont Plateau region of Maryland, Algonkian rocks are present infolded with the Paleozoic deposits of Montgomery, Frederick, and Carroll counties. They consist of a single type resembling the metamorphosed basic volcanic rocks (Catoctin schist) of the Blue Ridge district.

[1] Principles of North American pre-Cambrian geology, by C. R. VAN HISE: 16th Ann. Rept. U. S. Geol. Surv., 1894–5 pp. 686–688.

[2] The physical features of Maryland, including the physiography, geology, and mineral resources, by WM. B. CLARK: Maryland Geol. Survey, preliminary publication of Vol. I, Pt. III, 1897, pp. 95. With map.

[3] Geology and Physical Features of Maryland, by G. H. WILLIAMS and WM. B. CLARK. Extract from World's Fair Book on Maryland; Baltimore, 1893.

Comments.—The use of the term *Archean* in two senses is objectionable. If it is used for all rocks older than the Cambrian, then another name should be applied to the basal complex. If, following the usage of the U. S. Geol. Survey, Archean is confined to the basal complex unconformably below the Algonkian, the general term for all rocks below the Cambrian should be *pre-Cambrian*.

Clark[1] describes the physical features and geology of Maryland, and gives a sketch of the development of knowledge concerning them. The description of pre-Cambrian geology is essentially the same as that given by Clark in a preliminary publication of this part of the volume,[2] and this in turn is but slightly different from an account given by Williams and Clark in 1893. Both of these articles are reviewed above. However, a few minor changes may be noted. The crystalline rocks of the Piedmont Plateau region, instead of being divided into six types as before, are divided, into seven typesdiorite being added to the list. Rocks of the Archean period are placed in the table of formations as doubtfully present.

Keyes[3] gives a detailed petrographical description of the Maryland granites. For reasons the same as given by Williams they are regarded as eruptive, and many of the gneisses are shown to be dynamically metamorphosed granites.

Darton[4] maps and describes the geology of the Fredericksburg sheet of Virginia and Maryland. He finds in the northwest and west parts that granite, gneiss, and schist occur, and in the northwest

[1] WM. B. CLARK: Outline of present knowledge of the physical features of Maryland, embracing an account of the physiography, geology, and mineral resources; Maryland Geol. Survey, Vol. I, Pt. III, 1897, pp. 139–228; Historical Sketch, Pt. II, *ibid.*, pp. 43–138. With map.

[2] The physical features of Maryland, preliminary publication of Vol. I, Pt. II, 1897.

Geology and physical features of Maryland, by G. H. WILLIAMS and WM. B. CLARK. Extract from World's Fair Book on Maryland; Baltimore, 1893.

[3] Origin and Relations of Central Maryland Granites, by C. R. KEYES, with an Introduction on the General Relations of the Granitic Rocks in the Middle Atlantic Piedmont Plateau, by G. H. WILLIAMS. Fifteenth Ann. Rep. U. S. Geol. Surv., 1895, pp. 685–740. Pls. XXXVI–XLVIII.

[4] Geol. Atlas of the U. S., Fredericksburg Folio, No. 13, by N. H. DARTON: U. S. Geol. Surv., Washington, 1894.

part of the area a belt of rock called the Quantico slate. This slate locally appears to grade into siliceous mica-schist or gneiss. It is about three-quarters of a mile in width, and strikes northeast and southwest. The granite, gneiss, and schist are regarded as pre-Cambrian. The slates resemble the roofing slates on James River, which carry Lower Silurian fossils.

Kimball[1] describes the magnetite belt at Cranberry, N. C., and indicates the mode of development of the magnetite. The ore belt occurs in the crystalline schists forming Cranberry Ridge. These schists are mostly basic, pyroxene and amphibole prevailing. It is suggested that they are of Algonkian age.

Keith[2] maps and describes the geology of the Knoxville quadrangle of Tennessee and North Carolina, and of the Loudon quadrangle of Tennessee. Ocoee rocks form the mountain areas. From the base upward the series comprises the Wilhite slate, the Citico conglomerate, the Pigeon slate, the Cades conglomerate, the Thunderhead conglomerate, the Hazel slate, and the Clingman conglomerate.

The Wilhite slate is bluish-gray or black argillaceous slate. In its upper portion it becomes calcareous, and contains frequent beds of limestone and limestone conglomerate. The thickness is ordinarily from 300 to 400 feet. The Citico conglomerate is entirely siliceous, and varies from fine white sandstone to coarse quartz conglomerate, with a few thin beds of sandy shale. The Pigeon slate is mainly an argillaceous slate of great uniformity, occasionally banded by thin seams of coarser siliceous material. The thickness varies from 1300 to 1700 feet.

The Cades conglomerate, the Thunderhead conglomerate, the Hazel slate, and the Clingman conglomerate, are not described for the Loudon quadrangle.

For the Knoxville quadrangle the Cades conglomerate consists of thick beds of slate, sandstone, graywacke, and conglomerate. The

[1] The magnetite belt of Cranberry, N. C., by J. P. KIMBALL: Am. Geol., Vol. 20, 1897, pp. 299–312.

[2] Geol. Atlas of the U. S., Knoxville folio, No. 16, by ARTHUR KEITH: U. S., Geol. Surv., Washington, 1895.

Ibid., London folio, No. 25, 1896.

apparent thickness is 2400 feet, and this may be an overestimate, because the formation may be repeated by folding. The Thunderhead conglomerate consists of a series of conglomerates, graywackes, and sandstones, with many small beds of slate. The thickness is believed to be about 3000 feet. The Hazel slate is chiefly a black slate, but it contains many thin beds of sandstone and conglomerate in small quantity. The exact thickness cannot be ascertained, but it is believed to be about 700 feet. The Clingman conglomerate is the same in composition as the Thunderhead conglomerate, except that in the Clingman conglomerate there is smaller development of slate beds.

The age of the Ocoee rocks is undetermined, and they are therefore mapped as of unknown age.

Hayes[1] maps and describes the geology of the Cleveland quadrangle of Tennessee. Ocoee rocks occupy the southeastern part of the quadrangle, forming Big Frog Mountain and the plateau along its western base. No fossils have yet been found in these rocks, and they are separated by a great fault from rocks of known age, so that their position in the stratigraphic column cannot be fixed with certainty, but since they bear the marks of extreme age, they are considered as probably Algonkian. The Ocoee series comprises in this area the following formations, from the base upward: the Wilhite slate, the Citico conglomerate, the Pigeon slate, and the Thunderhead conglomerate and slate. Their correlation with formations bearing the same names in the Knoxville quadrangle to the northeast, described by Keith, is only approximate. The Wilhite slate consist in the main of dark blue or black slate. The Citico conglomerate varies from a coarse, massive conglomerate to fine grained sandstone or quartzite in sandy shale. The thickness varies from 500 to 1150 or more feet. The Pigeon slate resembles the Wilhite slate, the chief difference being a frequently observed banding and an abundance of interbedded gray schistose sandstones and graywackes, and occasional conglomerates. The Thunderhead conglomerate and slate can be separated into three divisions. The lowest of these, from 800 to 1000 feet thick, is a massively bedded conglomerate, made up largely of blue quartz and feldspar pebbles. The middle division consists of interbedded black slate and schistose conglomerate or sandstone, the slate apparently

[1] Geol. Atlas of the U. S., Cleveland folio, No. 20, by C. W. HAYES: U. S. Geol. Surv., Washington, 1895.

predominating. The upper division is also composed of conglomerate and slate, but the slate is comparatively unimportant.

King[1] describes the geology of the "Crystalline Belt" of Georgia, in connection with the occurrence of corundum. The Crystalline Belt occupies an area of 12,430 square miles, crossing the northern part of Georgia from the northeast to the southwest, and lying between Paleozoic strata in the northwest corner of the state, and Mesozoic and Cenozoic strata in the southern half of the state.

The rocks of the Crystalline Belt are divisable into two petrographical classes. The first consists of a series of mica-schists, slates, shales, conglomerate, and marble, which, though more or less crystalline, show evidence of clastic character. This class is called the *semicrystalline* series. The semicrystalline rocks are confined to an area bordering the Paleozoic to the northwest. The second class comprises eight types of rock. Three of them, limestone, quartzite, and slate, are undoubtedly clastic; three of them, granite, gneiss, and mica-schist, are completely crystalline and show no trace of clastic character; and two, peridotite, and diorite, are presumably of eruptive origin. Gneiss and mica-schist are the prevailing rocks. This second class is termed the *holocrystalline* series.

The rocks of the Crystalline Belt are separated from the Paleozoics on the northwest by a strong unconformity. Between the semicrystalline and holocrystalline rocks there is apparent transition.

Throughout the Crystalline Belt there is a uniform dip to the southeast, pointing toward a moving force from the southeast, but in the holo-crystalline area the dip is much steeper than in the semicrystalline area. Disturbances and alterations are more extensive in the holocrystalline rocks than in the semicrystalline rocks. Corundum is present only in the holocrystalline rocks.

From these facts it is believed that the holocrystalline area is older than the semicrystalline area, and formed the continent against which washed the waters of the sea which deposited the rocks of the semicrystalline series. While a portion of the holocrystalline series may be Archean, because of the presence in it of undoubted clastics the series is referred to the Algonkian. The same reference is made for the semicrystalline rocks.

[1] Corundum deposits of Georgia, Chap. iv, Geology of the Crystalline Belt, by FRANCIS P. KING: Bull. Geol. Surv. of Georgia, No. 2, 1894, pp. 58–72.

The history, varieties, and characters of corundum, and its mode of occurrence in the holocrystalline rocks, are fully described.

Smith[1] gives a general account of the character, distribution, and structure of the crystalline rocks of Alabama. The rocks are altered sedimentary and igneous rocks. The altered sedimentary rocks, called the Talledega or Ocoee series, is referred to the Algonkian, and the altered igneous rocks are referred to the Archean.

The Talledega series is found in the northeastern part of the state, in four or five roughly parallel belts, running northeast and southwest, the strata in general dipping to the southeast. The series comprises, in order of abundance, clay-slates or argillites, in places impregnated with graphite, quartzites and quartzite conglomerates, and crystalline limestones or dolomites. The slates, quartzites, and conglomerates resemble very strongly certain strata of undoubted Cambrian age, and it is probable that some of the strata included with the Talledega are altered Cambrian rocks. As yet, however, no fossils have been discovered in them.

The altered igneous rocks occur in three main belts roughly parallel with the sedimentary belts in the northeastern part of the state. In order of abundance they are gneisses and mica-schists, cut by dikes of granite, diorite, and various hornblendic, pyroxenic, and chrysolitic rocks.

Gold ores are associated with both the sedimentary and igneous series. Their mode of occurrence is briefly sketched.

Brooks,[2] in petrographical notes on some metamorphic rocks from Alabama, makes general statements concerning the geology of the metamorphic rocks of Alabama and Georgia. The metamorphic rocks of Alabama and Georgia may be differentiated into two series. The older, or crystalline series, includes crystalline schists and gneisses, whose origin is doubtful, together with large masses of gneissoid granite. The younger, or clastic series, is typically made up of phyllites, sericite-schists, chlorite-schists, conglomerates, quartzites, crystal-

[1] A general account of the character, distribution, and structure of the crystalline rocks of Alabama, and of the mode of occurrence of the gold ores, by E. A. SMITH: Bull. Geol. Surv. of Alabama, No. 5, 1896, pp. 108–130.

[2] Preliminary petrographic notes on some metamorphic rocks from Eastern Alabama, by A. H. BROOKS: Bull. Geol. Surv. of Alabama, No. 5, 1896, pp. 177–197,

line sandstones, and in a portion of the region limestones and marbles. The rocks of both series are closely associated with rocks of undoubted igneous origin.

Clements[1] gives notes on the microscopical character of certain rocks from the crystalline area of northeastern Alabama. The rocks include sedimentary and igneous rocks, and others whose origin is unknown. The sedimentary rocks are comparatively unimportant. Disregarding the sedimentary rocks, the rocks as a whole have the characters of Archean rocks.

Hawes[2] gives notes on the microscopical characters of the Alabama crystalline or metamorphic rocks.

Darton,[3] in connection with a discussion of artesian well prospects in the Atlantic Coastal Plain region, briefly describes the occurrence of the crystalline rocks. The crystalline rocks, predominantly granite and gneiss, outcrop along a line which passes from New York City through Philadelphia, Baltimore, Richmond, Weldon, and Columbia, to Augusta, Ga., and thence through Georgia and Alabama. Westward they extend up the gentle slope of the Piedmont Plateau to the base of the Appalachians. To the east they dip below unconsolidated sedimentaries, and along the ocean shore, from New Jersey south, they are 2000 feet below the surface.

GENERAL COMMENTS.

As yet the broader structural problems of the crystalline and semi-crystalline rocks of the Appalachian region and the Piedmont Plateau are far from completely solved. It is certain that some of the semi-crystalline rocks which in former years have been called Algonkian or Archean are Paleozoic. It seems equally certain that in the Appalachian and Piedmont Plateau region are greatly metamorphosed sedi-

[1] Notes on the microscopical character of certain rocks from Northeast Alabama, by J. MORGAN CLEMENTS: Bull. Geol. Surv. of Alabama, No. 5, 1896, pp. 133–176.

[2] Notes on the microscopic characters of the Alabama crystalline or metamorphic rocks, by G. W. HAWES: Bull. Geol. Surv. of Alabama, No. 5, 1896, pp. 131–132.

[3] Artesian well prospects in the Atlantic Coastal Plain region, by N. H. DARTON: Bull. U. S. Geol. Surv., No. 138, 1896, pp. 18–19.

mentary rocks, many of them being completely crystalline schists and gneisses, which are of pre-Paleozoic age. Further, in this region is a great series of sedimentary rocks known as the Ocoee series, the position of which is not determined, but which may include both Paleozoic and pre-Paleozoic rocks. Apparently all of the series of sedimentary rocks thus far mentioned rest unconformably upon a still older granite-gneiss-schist complex. It therefore appears clear that there are at least three series of rocks represented in the Appalachian region and the Piedmont Plateau, and there may be more.

Until the great structural problems of the Appalachian and Piedmont Plateau region are settled, the only safe course is to call pre-Paleozoic the rocks which are certainly below the Paleozoic, leaving open the question of their further classification as Archean or Algonkian. In the case of the Ocoee, at the present time, the series cannot be placed even as closely as pre-Paleozoic. In work in Maryland, North Carolina, Tennessee, Alabama, and Georgia, as shown by the above summaries, this plan in some cases has not been followed, but rocks supposed to be of pre-Paleozoic age have been somewhat arbitrarily assigned to the Archean or Algonkian. The use of these names, without definite knowledge of the structural features as a basis for the reference, is a hindrance rather than a help to further classificatory work. When the age of a series in the region is more definitely determined, the rocks can be placed as Algonkian or Archean without contradicting previous statements. C. K. LEITH.